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December 13, 2017

DEC 1 4 2017

USEPA – Region 3
Air Protection Division
1650 Arch Street
Philadelphia, PA 19103-2029

**RE: NSPS SUBPART OOOOa ANNUAL REPORT FOR THE EM ENERGY PA LLC'S URSA MINOR WELL PAD LOCATED AT 205 WHITMIRE ROAD, WEST SUNBURY, PENNSYLVANIA (WELL # 1MH, 3MH, 5MH, 7MH, 9MH, 11BH, 13BH, 15BH) (HRP #EDG4001.AC)**

To Whom It May Concern:

HRP Associates Inc. (HRP) on behalf of EM Energy PA LLC is submitting this New Source Performance Standards (NSPS) Subpart OOOOa Report for the Ursa Minor Well Pad, located at 205 Whitmire Road, West Sunbury, Pennsylvania. The facility is required to submit an annual report as required by 40 CFR 60.5420a for the compliance period of September 16, 2016 through September 15, 2017.

Please note at the time of submission of this report, the Subpart OOOOa annual reports are allowed to be submitted via hard copy because this report submission is within 90 days of the final template posted in CEDRI.

The certificate of Truth, Accuracy, and Completeness is included as Attachment 1.

**Completions:**

No well completion activities occurred during the reporting period.

**Centrifugal Compressors:**

There were no centrifugal compressors on site during this period.

**Reciprocating Compressors:**

The reciprocating compressor located on site is not considered an affected facility because it is located on the wellpad.

**Pneumatic Controllers:**

There were no pneumatic controllers on site during this period.

**Storage Tanks:**

The wellpad consists of three (3) condensate storage tanks and three (3) brine storage tanks. Each tank's potential emissions exceed 6 tons VOC per year and as a result, are considered an affected facility under Subpart OOOOa.

(i) Location of tanks:
- Condensate Tank 1 – 40.94796 N / -79.87072 E

- Condensate Tank 2 – 40.94796 N / -79.87066 E
- Condensate Tank 3 – 40.94796 N / -79.87061 E
- Brine Tank 1 – 40.94791 N / -79.87072 E
- Brine Tank 2 – 40.94791 N / -79.87066 E
- Brine Tank 3 – 40.94791 N / -79.87061 E

(ii) See Attachment 2 for VOC emission rates calculated using the API E&P TANKS model.
(iii) No deviations occurred during the reporting period.
(iv) The facility currently operates a LEED Fabrication 36" Enclosed Combustor with a 98% VOC destruction efficiency. The tanks are also equipped with a certified closed vent system.
(v) No tanks were removed from service during the reporting period.
(vi) No tanks returned to service during the reporting period.
(vii) See next section for information regarding the control device

**Storage Tank Control Device:**

There is one enclosed combustor used to control VOC emissions from the storage tanks on the wellpad. Below is information pertaining to the device:

- LEED Fabricator 36" Enclosed Combustor
- Serial Number - 25062
- See Attachment 3 for copy of purchase order
- Location: 40.94794 N / -79.87128 E
- Inlet gas flow rate – 99 Mscfd
- Upstream of the enclosed combustor has an Emergency Shutdown Valve (ESD) that will shut off gas flow to the control device anytime the pilot light is not lit
- Visible emissions were not observed during the reporting period
- No maintenance or repairs occurred during the reporting period
- The manufacturer's written operating instructions, procedures, and maintenance procedures can be found in Attachment 4

**Fugitive Emission Survey**

- Date of Survey: September 12, 2017
- Beginning Time of Survey: 9:25 AM
- End Time of Survey: 10:45 AM
- Name of Operator Performing survey: Melissa Sullivan – 5+ years of FLIR experience, Montrose Certified Operator, ITC FACT Certified Operator, and ITC Certified Infrared Thermograph certified in Optical Gas Imaging exp. 6/14/2022
- Ambient Temperature: 68 F
- Sky Conditions: Cloudy
- Maximum Wind Speed: 1 mph
- Monitoring Instrument Used: FLIR GF 320
- The only identified deviation was that the beginning and end times were not noted on the final LDAR report. Measures have been taken to ensure the start and end times are included on future LDAR reports.
- Number and type of components for which fugitive emissions were detected:
    - GPU#7MH Inlet SDE SS Tubing for Acuating – Swage Fitting (LDAR ID: 12823.0)
    - GPU#7MH Inlet SDE SS Tubing for Acuating – Swage Fitting (LDAR ID: 12823.1)

  - GPU#7MH – Separator Pressure Relief Valve (LDAR ID: 12824)
- Number and type of fugitive emissions components that were not repaired :
  - GPU#7MH – Separator Pressure Relief Valve (LDAR ID: 12824)
- Number and type of difficult-to-monitor and unsafe-to-monitor fugitive emission components monitored: No components have been identified as difficult-to-monitor or unsafe-to-monitor at this time
- The date of successful repair of the fugitive emissions component:
  - LDAR ID: 12823.0 – Repaired on 9/12/2017
  - LDAR ID: 12823.1 – Repaired on 9/12/2017
- Number and type of fugitive emission components placed on delay of repair and explanation for each delay of repair:
  - LDAR ID: 12824 – Put on Delay of Repair because parts were unavailable. The well was shut in.
- Type of instrument used to resurvey a repaired fugitive emissions component that could not be repaired during the initial fugitive emissions finding: Not Applicable

If you have any questions, comments, or require any additional information, please feel free to contact the undersigned at (518) 877-7101 extension 112.

Sincerely,
HRP Associates, Inc.

Brandon Cooper, EIT
Senior Project Engineer

Thomas S. Seguljic, P.E.
Vice President

**Attachments:**

Attachment 1: Certificate of Truth, Accuracy, and Completeness
Attachment 2: Tank Emission Calculations
Attachment 3: Control Device Purchase Order
Attachment 4: Enclosed Combustor Installation, Operation & Maintenance Manual

**Cc:** PADEP – Oil and Gas Division, Meadville, PA
Kay Thomas – EM Energy PA LLC, Canonsburg, PA

# Attachment 1

## Certificate of Truth, Accuracy, and Completeness

United States Environmental Protection Agency

OMB No. 2060-0336,
Approval Expires 05/31/2019

Federal Operating Permit Program (40 CFR Part 71)
**CERTIFICATION OF TRUTH, ACCURACY, AND COMPLETENESS (CTAC)**

This form must be completed, signed by the "Responsible Official" designated for the facility or emission unit, and sent with each submission of documents (i.e., application forms, updates to applications, reports, or any information required by a part 71 permit).

**A. Responsible Official**

Name: (Last) Stiegel (First) Gary (MI) ____

Title Senior Permitting Engineer

Street or P.O. Box 1800 Main Street, Suite 220

City Canonsburg State PA ZIP 15317 - ____

Telephone (412) 564 - 1298 Ext. _____ Facsimile (____) ____ - _____

**B. Certification of Truth, Accuracy and Completeness** (to be signed by the responsible official)

I certify under penalty of law, based on information and belief formed after reasonable inquiry, the statements and information contained in these documents are true, accurate and complete.

Name (signed) _____

Name (typed) Gary Stiegel Date: 12/13/17

# Attachment 2

## Tank Emission Calculations

# Condensate Tank VOC Emission Calculations

```
**********************************************************************************************
*     Project Setup Information                                                              *
**********************************************************************************************
Project File               : S:\Data\E\EDGMA - EDGE MARC ENERGY HOLDINGS LLC\Tank Emission Calculations\Condensate\Ursa I
Flowsheet Selection        : Oil Tank with Separator
Calculation Method         : RVP Distillation
Control Efficiency         : 98.00%
Known Separator Stream     : Low Pressure Oil
Entering Air Composition   : No
Component Group            : C10+

Date                       : 2017.05.17


**********************************************************************************************
*     Data Input                                                                             *
**********************************************************************************************

Separator Pressure (psia)          : 262.00
Separator Temperature (F)          : 82.0
C10+ SG                            : 0.78
C10+ MW(lb/lbmol)                  : 153.90

-- Low Pressure Oil ------------------------------------------------------------------------
No.    Component           Mole%    Wt%
1      H2S                   0.0000   0.0000
2      O2                    0.0000   0.0000
3      CO2                   0.0160   0.0085
4      N2                    0.0140   0.0047
5      C1                    6.8110   1.3194
6      C2                    7.9890   2.9012
7      C3                    9.2430   4.9226
8      i-C4                  2.4550   1.7232
9      n-C4                  8.4310   5.9177
10     i-C5                  4.2500   3.7032
11     n-C5                  7.0010   6.1002
12     C6                    5.1240   5.3316
13     C7                   12.6630  15.3232
14     C8                   12.5960  17.3764
15     C9                    5.5050   8.5283
16     C10+                  9.4430  17.5507
17     Benzene               0.0910   0.0858
18     Toluene               0.5350   0.5953
19     E-Benzene             0.4890   0.6270
20     Xylenes               1.3990   1.7938
21     n-C6                  5.9450   6.1873
22     224Trimethylp         0.0000   0.0000

-- Sales Oil -------------------------------------------------------------------------------
Production Rate in October (bbl/day): 6.90
Days of October Operation     : 31
Production Rate in November (bbl/day): 48.50
Days of November Operation    : 30
Production Rate in December (bbl/day): 19.58
Days of December Operation    : 31
API Gravity                   : 67.85
Reid Vapor Pressure (psia)    : 11.68
---- October ----------------------------------------
Ambient Pressure (psia)       : 14.70
Ambient Temperature of (F)    : 60.0
Min Ambient Temperature (F)   : 29.5
Max Ambient Temperature (F)   : 43.6
Total Solar Insolation (F)    : 831.00
---- November ---------------------------------------
Ambient Pressure (psia)       : 14.70
Ambient Temperature of (F)    : 60.0
```

- Condensate composition was taken from the Ursa Major Wellpad owned by EM Energy in Pennsylvania. Based on a similar gas analysis between Ursa Minor and Ursa Major, this sample was used to estimate tank emissions
- Emissions are per tank (3 total condensate tanks on-site)

Min Ambient Temperature (F) : 29.5
Max Ambient Temperature (F) : 43.6
Total Solar Insolation (F) : 831.00
---- December ----------
Ambient Pressure (psia) : 14.70
Ambient Temperature of (F) : 60.0
Min Ambient Temperature (F) : 29.5
Max Ambient Temperature (F) : 43.6
Total Solar Insolation (F) : 831.00

**********
* Calculation Results *
**********

-- Emission Summary (October) ----------

| | Uncontrolled ton | Controlled ton |
|---|---|---|
| Total HAPs | 0.0440 | 0.0009 |
| Total HC | 3.6640 | 0.0733 |
| VOCs, C2+ | 3.2670 | 0.0653 |
| VOCs, C3+ | 2.3960 | 0.0479 |
| CO2 | 0.0030 | |
| CH4 | 0.3970 | |

Uncontrolled Recovery Information:
Vapor(SCF/day): 2450.0000
HC Vapor(mscfd): 2.4500
CO2(mscfd): 0.0000
CH4(mscfd): 0.6000
GOR(SCF/STB): 37.6923

-- Emission Composition (October) ----------

| NoComponent | Uncontrolled ton | Controlled ton |
|---|---|---|
| 1 H2S | 0.0000 | 0.0000 |
| 2 O2 | 0.0000 | 0.0000 |
| 3 CO2 | 0.0030 | 0.0030 |
| 4 N2 | 0.0010 | 0.0010 |
| 5 C1 | 0.3970 | 0.0079 |
| 6 C2 | 0.8710 | 0.0174 |
| 7 C3 | 1.2380 | 0.0248 |
| 8 i-C4 | 0.2200 | 0.0044 |
| 9 n-C4 | 0.5400 | 0.0108 |
| 10 i-C5 | 0.1320 | 0.0026 |
| 11 n-C5 | 0.1580 | 0.0032 |
| 12 C6 | 0.0370 | 0.0007 |
| 13 Benzene | 0.0010 | 0.0000 |
| 14 Toluene | 0.0010 | 0.0000 |
| 15 E-Benzene | 0.0000 | 0.0000 |
| 16 Xylenes | 0.0010 | 0.0000 |
| 17 n-C6 | 0.0420 | 0.0008 |
| 18 224Trimethylp | 0.0000 | 0.0000 |
| 19 Pseudo Comp1 | 0.0190 | 0.0004 |
| 20 Pseudo Comp2 | 0.0080 | 0.0002 |
| 21 Pseudo Comp3 | 0.0010 | 0.0000 |
| 22 Pseudo Comp4 | 0.0000 | 0.0000 |
| 23 Pseudo Comp5 | 0.0000 | 0.0000 |
| 24 Total | 3.6700 | 0.0734 |

-- Stream Data (October) ----------

| NoComponent | MW lb/lbmol | LP Oil mole % | Flash Oil mole % | Sales Oil mole % | Flash Gas mole % | W&S Gas mole % | Total Emission mole % |
|---|---|---|---|---|---|---|---|
| 1 H2S | 34.80 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 O2 | 32.00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 CO2 | 44.01 | 0.0160 | 0.0012 | 0.0000 | 0.0669 | 0.0189 | 0.0580 |
| 4 N2 | 28.01 | 0.0140 | 0.0001 | 0.0000 | 0.0620 | 0.0013 | 0.0507 |
| 5 C1 | 16.04 | 6.8110 | 0.1905 | 0.0000 | 29.6385 | 2.8859 | 24.6779 |
| 6 C2 | 30.07 | 7.9890 | 1.5481 | 0.0091 | 30.1976 | 23.3184 | 28.9220 |
| 7 C3 | 44.10 | 9.2430 | 5.2094 | 2.0883 | 23.1511 | 49.3633 | 28.0115 |
| 8 i-C4 | 58.12 | 2.4550 | 2.1748 | 1.9502 | 3.4213 | 5.3502 | 3.7790 |
| 9 n-C4 | 58.12 | 8.4310 | 8.3907 | 8.1113 | 8.5699 | 12.3442 | 9.2698 |
| 10 i-C5 | 72.15 | 4.2500 | 4.9865 | 5.1760 | 1.7105 | 2.3072 | 1.8211 |
| 11 n-C5 | 72.15 | 7.0010 | 8.4380 | 8.8383 | 2.0463 | 2.7750 | 2.1814 |
| 12 C6 | 84.00 | 5.1240 | 6.4912 | 6.9091 | 0.4099 | 0.5790 | 0.4413 |
| 13 Benzene | 78.11 | 0.0910 | 0.1157 | 0.1232 | 0.0060 | 0.0085 | 0.0064 |
| 14 Toluene | 92.14 | 0.5350 | 0.6877 | 0.7355 | 0.0084 | 0.0126 | 0.0092 |
| 15 E-Benzene | 106.17 | 0.4890 | 0.6302 | 0.6745 | 0.0022 | 0.0034 | 0.0024 |
| 16 Xylenes | 106.17 | 1.3990 | 1.8033 | 1.9302 | 0.0050 | 0.0079 | 0.0055 |
| 17 n-C6 | 86.18 | 5.9450 | 7.5378 | 8.0259 | 0.4529 | 0.6335 | 0.4864 |
| 18 224Trimethylp | 114.24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 19 Pseudo Comp1 | 96.00 | 12.6630 | 16.2847 | 17.4167 | 0.1752 | 0.2701 | 0.1928 |
| 20 Pseudo Comp2 | 107.00 | 12.5960 | 16.2302 | 17.3702 | 0.0653 | 0.1025 | 0.0722 |
| 21 Pseudo Comp3 | 121.00 | 5.5050 | 7.0990 | 7.5998 | 0.0087 | 0.0141 | 0.0097 |
| 22 Pseudo Comp4 | 138.83 | 6.1437 | 7.9248 | 8.4847 | 0.0024 | 0.0040 | 0.0027 |
| 23 Pseudo Comp5 | 182.25 | 3.2993 | 4.2562 | 4.5570 | 0.0000 | 0.0001 | 0.0000 |

| | LP Oil | Flash Oil | Sales Oil | Flash Gas | W&S Gas | Total Emission |
|---|---|---|---|---|---|---|
| MW (lb/lbmol): | 80.86 | 94.22 | 97.73 | 34.78 | 44.66 | 36.61 |
| Stream Mole Ratio: | 1.0000 | 0.7752 | 0.7240 | 0.2248 | 0.0512 | 0.2760 |
| Stream Weight Ratio: | 80.86 | 73.04 | 70.76 | 7.82 | 2.29 | 10.10 |
| Total Emission (ton): | | | | 2.838 | 0.830 | 3.668 |
| Heating Value (BTU/scf): | | | | 2011.73 | 2542.74 | 2110.20 |
| Gas Gravity (Gas/Air): | | | | 1.20 | 1.54 | 1.26 |
| Bubble Pt. @100F (psia): | 290.50 | 32.81 | 12.68 | | | |
| RVP @100F (psia): | 93.75 | 22.27 | 11.64 | | | |
| Spec. Gravity @100F: | 0.66 | 0.69 | 0.69 | | | |

-- Emission Summary (November) ----------

| | Uncontrolled ton | Controlled ton |
|---|---|---|
| Total HAPs | 0.3000 | 0.0060 |
| Total HC | 24.9110 | 0.4982 |
| VOCs, C2+ | 22.2150 | 0.4443 |
| VOCs, C3+ | 16.2910 | 0.3258 |
| CO2 | 0.0170 | |
| CH4 | 2.6960 | |

Uncontrolled Recovery Information:

| | |
|---|---|
| Vapor(SCF/day): | 17210.0000 |
| HC Vapor(mscfd): | 17.1900 |
| CO2(mscfd): | 0.0100 |
| CH4(mscfd): | 4.2500 |
| GOR(SCF/STB): | 264.7692 |

Largest Early Throughput:
Uncontrolled
16.2910 tons/month/tank * 12 months = 195.49 tons/year/tank
Controlled
0.3258 tons/month/tank * 12 months = 3.91 tons/year/tank

-- Emission Composition (November) ----------

| No | Component | Uncontrolled ton | Controlled ton |
|---|---|---|---|
| 1 | H2S | 0.0000 | 0.0000 |
| 2 | O2 | 0.0000 | 0.0000 |
| 3 | CO2 | 0.0170 | 0.0170 |
| 4 | N2 | 0.0100 | 0.0100 |
| 5 | C1 | 2.6960 | 0.0539 |
| 6 | C2 | 5.9240 | 0.1185 |
| 7 | C3 | 8.4150 | 0.1683 |
| 8 | i-C4 | 1.4960 | 0.0299 |
| 9 | n-C4 | 3.6700 | 0.0734 |
| 10 | i-C5 | 0.8950 | 0.0179 |
| 11 | n-C5 | 1.0720 | 0.0214 |
| 12 | C6 | 0.2520 | 0.0050 |
| 13 | Benzene | 0.0030 | 0.0001 |

| | | | |
|---|---|---|---|
| 14 | Toluene | 0.0060 | 0.0001 |
| 15 | E-Benzene | 0.0020 | 0.0000 |
| 16 | Xylenes | 0.0040 | 0.0001 |
| 17 | n-C6 | 0.2860 | 0.0057 |
| 18 | 224Trimethylp | 0.0000 | 0.0000 |
| 19 | Pseudo Comp1 | 0.1260 | 0.0025 |
| 20 | Pseudo Comp2 | 0.0530 | 0.0011 |
| 21 | Pseudo Comp3 | 0.0080 | 0.0002 |
| 22 | Pseudo Comp4 | 0.0030 | 0.0001 |
| 23 | Pseudo Comp5 | 0.0000 | 0.0000 |
| 24 | Total | 24.9380 | 0.4988 |

-- Stream Data (November) ----------

| NoComponent | MW | LP Oil | Flash Oil | Sales Oil | Flash Gas | W&S Gas | Total Emission |
|---|---|---|---|---|---|---|---|
| | lb/lbmol | mole % | mole % | mole % | mole % | mole % | mole % |
| 1 H2S | 34.80 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 O2 | 32.00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3 CO2 | 44.01 | 0.0160 | 0.0012 | 0.0000 | 0.0669 | 0.0189 | 0.0580 |
| 4 N2 | 28.01 | 0.0140 | 0.0001 | 0.0000 | 0.0620 | 0.0013 | 0.0507 |
| 5 C1 | 16.04 | 6.8110 | 0.1905 | 0.0000 | 29.6385 | 2.8859 | 24.6779 |
| 6 C2 | 30.07 | 7.9890 | 1.5481 | 0.0091 | 30.1976 | 23.3184 | 28.9220 |
| 7 C3 | 44.10 | 9.2430 | 5.2094 | 2.0883 | 23.1511 | 49.3633 | 28.0115 |
| 8 i-C4 | 58.12 | 2.4550 | 2.1748 | 1.9502 | 3.4213 | 5.3502 | 3.7790 |
| 9 n-C4 | 58.12 | 8.4310 | 8.3907 | 8.1113 | 8.5699 | 12.3442 | 9.2698 |
| 10 i-C5 | 72.15 | 4.2500 | 4.9865 | 5.1760 | 1.7105 | 2.3072 | 1.8211 |
| 11 n-C5 | 72.15 | 7.0010 | 8.4380 | 8.8383 | 2.0463 | 2.7750 | 2.1814 |
| 12 C6 | 84.00 | 5.1240 | 6.4912 | 6.9091 | 0.4099 | 0.5790 | 0.4413 |
| 13 Benzene | 78.11 | 0.0910 | 0.1157 | 0.1232 | 0.0060 | 0.0085 | 0.0064 |
| 14 Toluene | 92.14 | 0.5350 | 0.6877 | 0.7355 | 0.0084 | 0.0126 | 0.0092 |
| 15 E-Benzene | 106.17 | 0.4890 | 0.6302 | 0.6745 | 0.0022 | 0.0034 | 0.0024 |
| 16 Xylenes | 106.17 | 1.3990 | 1.8033 | 1.9302 | 0.0050 | 0.0079 | 0.0055 |
| 17 n-C6 | 86.18 | 5.9450 | 7.5378 | 8.0259 | 0.4529 | 0.6335 | 0.4864 |
| 18 224Trimethylp | 114.24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 19 Pseudo Comp1 | 96.00 | 12.6630 | 16.2847 | 17.4167 | 0.1752 | 0.2701 | 0.1928 |
| 20 Pseudo Comp2 | 107.00 | 12.5960 | 16.2302 | 17.3702 | 0.0653 | 0.1025 | 0.0722 |
| 21 Pseudo Comp3 | 121.00 | 5.5050 | 7.0990 | 7.5998 | 0.0087 | 0.0141 | 0.0097 |
| 22 Pseudo Comp4 | 138.83 | 6.1437 | 7.9248 | 8.4847 | 0.0024 | 0.0040 | 0.0027 |
| 23 Pseudo Comp5 | 182.25 | 3.2993 | 4.2562 | 4.5570 | 0.0000 | 0.0001 | 0.0000 |

| | LP Oil | Flash Oil | Sales Oil | Flash Gas | W&S Gas | Total Emission |
|---|---|---|---|---|---|---|
| MW (lb/lbmol): | 80.86 | 94.22 | 97.73 | 34.78 | 44.66 | 36.61 |
| Stream Mole Ratio: | 1.0000 | 0.7752 | 0.7240 | 0.2248 | 0.0512 | 0.2760 |
| Stream Weight Ratio: | 80.86 | 73.04 | 70.76 | 7.82 | 2.29 | 10.10 |
| Total Emission (ton): | | | | 19.298 | 5.641 | 24.938 |
| Heating Value (BTU/scf): | | | | 2011.73 | 2542.74 | 2110.20 |
| Gas Gravity (Gas/Air): | | | | 1.20 | 1.54 | 1.26 |
| Bubble Pt. @100F (psia): | 290.50 | 32.81 | 12.68 | | | |
| RVP @100F (psia): | 93.75 | 22.27 | 11.64 | | | |
| Spec. Gravity @100F: | 0.66 | 0.69 | 0.69 | | | |

-- Emission Summary (December) ----------

| | Uncontrolled | Controlled |
|---|---|---|
| | ton | ton |
| Total HAPs | 0.1250 | 0.0025 |
| Total HC | 10.3930 | 0.2079 |
| VOCs, C2+ | 9.2680 | 0.1854 |
| VOCs, C3+ | 6.7970 | 0.1359 |
| CO2 | 0.0070 | |
| CH4 | 1.1250 | |

Uncontrolled Recovery Information:

| | |
|---|---|
| Vapor(SCF/day): | 6950.0000 |
| HC Vapor(mscfd): | 6.9400 |
| CO2(mscfd): | 0.0000 |
| CH4(mscfd): | 1.7100 |

GOR(SCF/STB): 106.9231

-- Emission Composition (December) ----------

| No | Component | Uncontrolled ton | Controlled ton |
|---|---|---|---|
| 1 | H2S | 0.0000 | 0.0000 |
| 2 | O2 | 0.0000 | 0.0000 |
| 3 | CO2 | 0.0070 | 0.0070 |
| 4 | N2 | 0.0040 | 0.0040 |
| 5 | C1 | 1.1250 | 0.0225 |
| 6 | C2 | 2.4720 | 0.0494 |
| 7 | C3 | 3.5110 | 0.0702 |
| 8 | i-C4 | 0.6240 | 0.0125 |
| 9 | n-C4 | 1.5310 | 0.0306 |
| 10 | i-C5 | 0.3730 | 0.0075 |
| 11 | n-C5 | 0.4470 | 0.0089 |
| 12 | C6 | 0.1050 | 0.0021 |
| 13 | Benzene | 0.0010 | 0.0000 |
| 14 | Toluene | 0.0020 | 0.0000 |
| 15 | E-Benzene | 0.0010 | 0.0000 |
| 16 | Xylenes | 0.0020 | 0.0000 |
| 17 | n-C6 | 0.1190 | 0.0024 |
| 18 | 224Trimethylp | 0.0000 | 0.0000 |
| 19 | Pseudo Comp1 | 0.0530 | 0.0011 |
| 20 | Pseudo Comp2 | 0.0220 | 0.0004 |
| 21 | Pseudo Comp3 | 0.0030 | 0.0001 |
| 22 | Pseudo Comp4 | 0.0010 | 0.0000 |
| 23 | Pseudo Comp5 | 0.0000 | 0.0000 |
| 24 | Total | 10.4030 | 0.2081 |

-- Stream Data (December) ----------

| No | Component | MW lb/lbmol | LP Oil mole % | Flash Oil mole % | Sales Oil mole % | Flash Gas mole % | W&S Gas mole % | Total Emission mole % |
|---|---|---|---|---|---|---|---|---|
| 1 | H2S | 34.80 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | O2 | 32.00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3 | CO2 | 44.01 | 0.0160 | 0.0012 | 0.0000 | 0.0669 | 0.0189 | 0.0580 |
| 4 | N2 | 28.01 | 0.0140 | 0.0001 | 0.0000 | 0.0620 | 0.0013 | 0.0507 |
| 5 | C1 | 16.04 | 6.8110 | 0.1905 | 0.0000 | 29.6385 | 2.8859 | 24.6779 |
| 6 | C2 | 30.07 | 7.9890 | 1.5481 | 0.0091 | 30.1976 | 23.3184 | 28.9220 |
| 7 | C3 | 44.10 | 9.2430 | 5.2094 | 2.0883 | 23.1511 | 49.3633 | 28.0115 |
| 8 | i-C4 | 58.12 | 2.4550 | 2.1748 | 1.9502 | 3.4213 | 5.3502 | 3.7790 |
| 9 | n-C4 | 58.12 | 8.4310 | 8.3907 | 8.1113 | 8.5699 | 12.3442 | 9.2698 |
| 10 | i-C5 | 72.15 | 4.2500 | 4.9865 | 5.1760 | 1.7105 | 2.3072 | 1.8211 |
| 11 | n-C5 | 72.15 | 7.0010 | 8.4380 | 8.8383 | 2.0463 | 2.7750 | 2.1814 |
| 12 | C6 | 84.00 | 5.1240 | 6.4912 | 6.9091 | 0.4099 | 0.5790 | 0.4413 |
| 13 | Benzene | 78.11 | 0.0910 | 0.1157 | 0.1232 | 0.0060 | 0.0085 | 0.0064 |
| 14 | Toluene | 92.14 | 0.5350 | 0.6877 | 0.7355 | 0.0084 | 0.0126 | 0.0092 |
| 15 | E-Benzene | 106.17 | 0.4890 | 0.6302 | 0.6745 | 0.0022 | 0.0034 | 0.0024 |
| 16 | Xylenes | 106.17 | 1.3990 | 1.8033 | 1.9302 | 0.0050 | 0.0079 | 0.0055 |
| 17 | n-C6 | 86.18 | 5.9450 | 7.5378 | 8.0259 | 0.4529 | 0.6335 | 0.4864 |
| 18 | 224Trimethylp | 114.24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 19 | Pseudo Comp1 | 96.00 | 12.6630 | 16.2847 | 17.4167 | 0.1752 | 0.2701 | 0.1928 |
| 20 | Pseudo Comp2 | 107.00 | 12.5960 | 16.2302 | 17.3702 | 0.0653 | 0.1025 | 0.0722 |
| 21 | Pseudo Comp3 | 121.00 | 5.5050 | 7.0990 | 7.5998 | 0.0087 | 0.0141 | 0.0097 |
| 22 | Pseudo Comp4 | 138.83 | 6.1437 | 7.9248 | 8.4847 | 0.0024 | 0.0040 | 0.0027 |
| 23 | Pseudo Comp5 | 182.25 | 3.2993 | 4.2562 | 4.5570 | 0.0000 | 0.0001 | 0.0000 |

| | LP Oil | Flash Oil | Sales Oil | Flash Gas | W&S Gas | Total Emission |
|---|---|---|---|---|---|---|
| MW (lb/lbmol): | 80.86 | 94.22 | 97.73 | 34.78 | 44.66 | 36.61 |
| Stream Mole Ratio: | 1.0000 | 0.7752 | 0.7240 | 0.2248 | 0.0512 | 0.2760 |
| Stream Weight Ratio: | 80.86 | 73.04 | 70.76 | 7.82 | 2.29 | 10.10 |
| Total Emission (ton): | | | | 8.051 | 2.353 | 10.404 |
| Heating Value (BTU/scf): | | | | 2011.73 | 2542.74 | 2110.20 |
| Gas Gravity (Gas/Air): | | | | 1.20 | 1.54 | 1.26 |
| Bubble Pt. @100F (psia): | 290.50 | 32.81 | 12.68 | | | |

| | | | |
|---|---|---|---|
| RVP @100F (psia): | 93.75 | 22.27 | 11.64 |
| Spec. Gravity @100F: | 0.66 | 0.69 | 0.69 |

-- Emission Summary (Total) ----------

| | Uncontrolled ton | Controlled ton |
|---|---|---|
| Total HAPs | 0.4690 | 0.0094 |
| Total HC | 38.9680 | 0.7794 |
| VOCs, C2+ | 34.7500 | 0.6950 |
| VOCs, C3+ | 25.4840 | 0.5097 |
| CO2 | 0.0270 | |
| CH4 | 4.2180 | |

-- Emission Composition (Total) ----------

| NoComponent | Uncontrolled ton | Controlled ton |
|---|---|---|
| 1 H2S | 0.0000 | 0.0000 |
| 2 O2 | 0.0000 | 0.0000 |
| 3 CO2 | 0.0270 | 0.0270 |
| 4 N2 | 0.0150 | 0.0150 |
| 5 C1 | 4.2180 | 0.0844 |
| 6 C2 | 9.2670 | 0.1853 |
| 7 C3 | 13.1640 | 0.2633 |
| 8 i-C4 | 2.3400 | 0.0468 |
| 9 n-C4 | 5.7410 | 0.1148 |
| 10 i-C5 | 1.4000 | 0.0280 |
| 11 n-C5 | 1.6770 | 0.0335 |
| 12 C6 | 0.3940 | 0.0079 |
| 13 Benzene | 0.0050 | 0.0001 |
| 14 Toluene | 0.0090 | 0.0002 |
| 15 E-Benzene | 0.0030 | 0.0001 |
| 16 Xylenes | 0.0070 | 0.0001 |
| 17 n-C6 | 0.4470 | 0.0089 |
| 18 224Trimethylp | 0.0000 | 0.0000 |
| 19 Pseudo Comp1 | 0.1980 | 0.0040 |
| 20 Pseudo Comp2 | 0.0830 | 0.0017 |
| 21 Pseudo Comp3 | 0.0120 | 0.0002 |
| 22 Pseudo Comp4 | 0.0040 | 0.0001 |
| 23 Pseudo Comp5 | 0.0000 | 0.0000 |
| 24 Total | 39.0110 | 0.7802 |

# Brine Tank VOC Emission Calculations

```
**********************************************************************************************
*     Project Setup Information                                                              *
**********************************************************************************************
Project File              : S:\Data\E\EDGMA - EDGE MARC ENERGY HOLDINGS LLC\Tank Emission Calculations\Brine\Ursa Mino
Flowsheet Selection       : Oil Tank with Separator
Calculation Method        : RVP Distillation
Control Efficiency        : 98.00%
Known Separator Stream    : Low Pressure Oil
Entering Air Composition  : No
Component Group           : C10+

Date                      : 2017.05.17


**********************************************************************************************
*     Data Input                                                                             *
**********************************************************************************************

Separator Pressure (psia)          : 262.00
Separator Temperature (F)          : 82.0
C10+ SG                            : 0.78
C10+ MW(lb/lbmol)                  : 153.90

-- Low Pressure Oil ------------------------------------------------------------------------
No.   Component           Mole%    Wt%
1     H2S                    0.0000   0.0000
2     O2                     0.0000   0.0000
3     CO2                    0.0160   0.0085
4     N2                     0.0140   0.0047
5     C1                     6.8110   1.3194
6     C2                     7.9890   2.9012
7     C3                     9.2430   4.9226
8     i-C4                   2.4550   1.7232
9     n-C4                   8.4310   5.9177
10    i-C5                   4.2500   3.7032
11    n-C5                   7.0010   6.1002
12    C6                     5.1240   5.3316
13    C7                    12.6630  15.3232
14    C8                    12.5960  17.3764
15    C9                     5.5050   8.5283
16    C10+                   9.4430  17.5507
17    Benzene                0.0910   0.0858
18    Toluene                0.5350   0.5953
19    E-Benzene              0.4890   0.6270
20    Xylenes                1.3990   1.7938
21    n-C6                   5.9450   6.1873
22    224Trimethylp          0.0000   0.0000

-- Sales Oil -------------------------------------------------------------------------------
Production Rate in October (bbl/day): 1.88
Days of October Operation     : 31
Production Rate in November (bbl/day): 6.39
Days of November Operation    : 30
Production Rate in December (bbl/day): 4.28
Days of December Operation    : 31
API Gravity                   : 67.85
Reid Vapor Pressure (psia)    : 11.68
---- October ----------------------------------------
Ambient Pressure (psia)       : 14.70
Ambient Temperature of (F)    : 60.0
Min Ambient Temperature (F)   : 29.5
Max Ambient Temperature (F)   : 43.6
Total Solar Insolation (F)    : 831.00
---- November ---------------------------------------
Ambient Pressure (psia)       : 14.70
Ambient Temperature of (F)    : 60.0
```

- Condensate composition was taken from the Ursa Major Wellpad owned by EM Energy in Pennsylvania. Based on a similar gas analysis between Ursa Minor and Ursa Major, this sample was used to estimate tank emissions
- Emissions are per tank (3 total brine tanks on-site)
- Brine volume is assumed to be 1% condensate

Min Ambient Temperature (F) : 29.5
Max Ambient Temperature (F) : 43.6
Total Solar Insolation (F) : 831.00
---- December ----------
Ambient Pressure (psia) : 14.70
Ambient Temperature of (F) : 60.0
Min Ambient Temperature (F) : 29.5
Max Ambient Temperature (F) : 43.6
Total Solar Insolation (F) : 831.00

**********
* Calculation Results *
**********

-- Emission Summary (October) ----------

| | Uncontrolled ton | Controlled ton |
|---|---|---|
| Total HAPs | 0.0120 | 0.0002 |
| Total HC | 0.9980 | 0.0200 |
| VOCs, C2+ | 0.8900 | 0.0178 |
| VOCs, C3+ | 0.6530 | 0.0131 |
| CO2 | 0.0010 | |
| CH4 | 0.1080 | |

Uncontrolled Recovery Information:
Vapor(SCF/day): 667.6200
HC Vapor(mscfd): 0.6669
CO2(mscfd): 0.0000
CH4(mscfd): 0.1600
GOR(SCF/STB): 10.2711

-- Emission Composition (October) ----------

| No | Component | Uncontrolled ton | Controlled ton |
|---|---|---|---|
| 1 | H2S | 0.0000 | 0.0000 |
| 2 | O2 | 0.0000 | 0.0000 |
| 3 | CO2 | 0.0010 | 0.0010 |
| 4 | N2 | 0.0000 | 0.0000 |
| 5 | C1 | 0.1080 | 0.0022 |
| 6 | C2 | 0.2370 | 0.0047 |
| 7 | C3 | 0.3370 | 0.0067 |
| 8 | i-C4 | 0.0600 | 0.0012 |
| 9 | n-C4 | 0.1470 | 0.0029 |
| 10 | i-C5 | 0.0360 | 0.0007 |
| 11 | n-C5 | 0.0430 | 0.0009 |
| 12 | C6 | 0.0100 | 0.0002 |
| 13 | Benzene | 0.0000 | 0.0000 |
| 14 | Toluene | 0.0000 | 0.0000 |
| 15 | E-Benzene | 0.0000 | 0.0000 |
| 16 | Xylenes | 0.0000 | 0.0000 |
| 17 | n-C6 | 0.0110 | 0.0002 |
| 18 | 224Trimethylp | 0.0000 | 0.0000 |
| 19 | Pseudo Comp1 | 0.0050 | 0.0001 |
| 20 | Pseudo Comp2 | 0.0020 | 0.0000 |
| 21 | Pseudo Comp3 | 0.0000 | 0.0000 |
| 22 | Pseudo Comp4 | 0.0000 | 0.0000 |
| 23 | Pseudo Comp5 | 0.0000 | 0.0000 |
| 24 | Total | 0.9970 | 0.0199 |

-- Stream Data (October) ----------

| No | Component | MW lb/lbmol | LP Oil mole % | Flash Oil mole % | Sales Oil mole % | Flash Gas mole % | W&S Gas mole % | Total Emission mole % |
|---|---|---|---|---|---|---|---|---|
| 1 | H2S | 34.80 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | O2 | 32.00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 CO2 | 44.01 | 0.0160 | 0.0012 | 0.0000 | 0.0669 | 0.0189 | 0.0580 |
| 4 N2 | 28.01 | 0.0140 | 0.0001 | 0.0000 | 0.0620 | 0.0013 | 0.0507 |
| 5 C1 | 16.04 | 6.8110 | 0.1905 | 0.0000 | 29.6385 | 2.8859 | 24.6779 |
| 6 C2 | 30.07 | 7.9890 | 1.5481 | 0.0091 | 30.1976 | 23.3184 | 28.9220 |
| 7 C3 | 44.10 | 9.2430 | 5.2094 | 2.0883 | 23.1511 | 49.3633 | 28.0115 |
| 8 i-C4 | 58.12 | 2.4550 | 2.1748 | 1.9502 | 3.4213 | 5.3502 | 3.7790 |
| 9 n-C4 | 58.12 | 8.4310 | 8.3907 | 8.1113 | 8.5699 | 12.3442 | 9.2698 |
| 10 i-C5 | 72.15 | 4.2500 | 4.9865 | 5.1760 | 1.7105 | 2.3072 | 1.8211 |
| 11 n-C5 | 72.15 | 7.0010 | 8.4380 | 8.8383 | 2.0463 | 2.7750 | 2.1814 |
| 12 C6 | 84.00 | 5.1240 | 6.4912 | 6.9091 | 0.4099 | 0.5790 | 0.4413 |
| 13 Benzene | 78.11 | 0.0910 | 0.1157 | 0.1232 | 0.0060 | 0.0085 | 0.0064 |
| 14 Toluene | 92.14 | 0.5350 | 0.6877 | 0.7355 | 0.0084 | 0.0126 | 0.0092 |
| 15 E-Benzene | 106.17 | 0.4890 | 0.6302 | 0.6745 | 0.0022 | 0.0034 | 0.0024 |
| 16 Xylenes | 106.17 | 1.3990 | 1.8033 | 1.9302 | 0.0050 | 0.0079 | 0.0055 |
| 17 n-C6 | 86.18 | 5.9450 | 7.5378 | 8.0259 | 0.4529 | 0.6335 | 0.4864 |
| 18 224Trimethylp | 114.24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 19 Pseudo Comp1 | 96.00 | 12.6630 | 16.2847 | 17.4167 | 0.1752 | 0.2701 | 0.1928 |
| 20 Pseudo Comp2 | 107.00 | 12.5960 | 16.2302 | 17.3702 | 0.0653 | 0.1025 | 0.0722 |
| 21 Pseudo Comp3 | 121.00 | 5.5050 | 7.0990 | 7.5998 | 0.0087 | 0.0141 | 0.0097 |
| 22 Pseudo Comp4 | 138.83 | 6.1437 | 7.9248 | 8.4847 | 0.0024 | 0.0040 | 0.0027 |
| 23 Pseudo Comp5 | 182.25 | 3.2993 | 4.2562 | 4.5570 | 0.0000 | 0.0001 | 0.0000 |

| | LP Oil | Flash Oil | Sales Oil | Flash Gas | W&S Gas | Total Emission |
|---|---|---|---|---|---|---|
| MW (lb/lbmol): | 80.86 | 94.22 | 97.73 | 34.78 | 44.66 | 36.61 |
| Stream Mole Ratio: | 1.0000 | 0.7752 | 0.7240 | 0.2248 | 0.0512 | 0.2760 |
| Stream Weight Ratio: | 80.86 | 73.04 | 70.76 | 7.82 | 2.29 | 10.10 |
| Total Emission (ton): | | | | 0.773 | 0.226 | 1.000 |
| Heating Value (BTU/scf): | | | | 2011.73 | 2542.74 | 2110.20 |
| Gas Gravity (Gas/Air): | | | | 1.20 | 1.54 | 1.26 |
| Bubble Pt. @100F (psia): | 290.50 | 32.81 | 12.68 | | | |
| RVP @100F (psia): | 93.75 | 22.27 | 11.64 | | | |
| Spec. Gravity @100F: | 0.66 | 0.69 | 0.69 | | | |

-- Emission Summary (November) ----------

| | Uncontrolled ton | Controlled ton |
|---|---|---|
| Total HAPs | 0.0400 | 0.0008 |
| Total HC | 3.2830 | 0.0657 |
| VOCs, C2+ | 2.9280 | 0.0586 |
| VOCs, C3+ | 2.1470 | 0.0429 |
| CO2 | 0.0020 | |
| CH4 | 0.3550 | |

Largest Early Throughput:
Uncontrolled
2.1470 tons/month/tank * 12 months = 25.76 tons/year/tank
Controlled
0.0429 tons/month/tank * 12 months = 0.5148 tons/year/tank

Uncontrolled Recovery Information:

| | |
|---|---|
| Vapor (SCF/day): | 2270.0000 |
| HC Vapor (mscfd): | 2.2700 |
| CO2 (mscfd): | 0.0000 |
| CH4 (mscfd): | 0.5600 |
| GOR (SCF/STB): | 34.9231 |

-- Emission Composition (November) ----------

| NoComponent | Uncontrolled ton | Controlled ton |
|---|---|---|
| 1 H2S | 0.0000 | 0.0000 |
| 2 O2 | 0.0000 | 0.0000 |
| 3 CO2 | 0.0020 | 0.0020 |
| 4 N2 | 0.0010 | 0.0010 |
| 5 C1 | 0.3550 | 0.0071 |
| 6 C2 | 0.7810 | 0.0156 |
| 7 C3 | 1.1090 | 0.0222 |
| 8 i-C4 | 0.1970 | 0.0039 |
| 9 n-C4 | 0.4840 | 0.0097 |
| 10 i-C5 | 0.1180 | 0.0024 |
| 11 n-C5 | 0.1410 | 0.0028 |
| 12 C6 | 0.0330 | 0.0007 |
| 13 Benzene | 0.0000 | 0.0000 |

| | | | |
|---|---|---|---|
| 14 | Toluene | 0.0010 | 0.0000 |
| 15 | E-Benzene | 0.0000 | 0.0000 |
| 16 | Xylenes | 0.0010 | 0.0000 |
| 17 | n-C6 | 0.0380 | 0.0008 |
| 18 | 224Trimethylp | 0.0000 | 0.0000 |
| 19 | Pseudo Comp1 | 0.0170 | 0.0003 |
| 20 | Pseudo Comp2 | 0.0070 | 0.0001 |
| 21 | Pseudo Comp3 | 0.0010 | 0.0000 |
| 22 | Pseudo Comp4 | 0.0000 | 0.0000 |
| 23 | Pseudo Comp5 | 0.0000 | 0.0000 |
| 24 | Total | 3.2860 | 0.0657 |

-- Stream Data (November) ----------

| No | Component | MW | LP Oil | Flash Oil | Sales Oil | Flash Gas | W&S Gas | Total Emission |
|---|---|---|---|---|---|---|---|---|
| | | lb/lbmol | mole % | mole % | mole % | mole % | mole % | mole % |
| 1 | H2S | 34.80 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | O2 | 32.00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3 | CO2 | 44.01 | 0.0160 | 0.0012 | 0.0000 | 0.0669 | 0.0189 | 0.0580 |
| 4 | N2 | 28.01 | 0.0140 | 0.0001 | 0.0000 | 0.0620 | 0.0013 | 0.0507 |
| 5 | C1 | 16.04 | 6.8110 | 0.1905 | 0.0000 | 29.6385 | 2.8859 | 24.6779 |
| 6 | C2 | 30.07 | 7.9890 | 1.5481 | 0.0091 | 30.1976 | 23.3184 | 28.9220 |
| 7 | C3 | 44.10 | 9.2430 | 5.2094 | 2.0883 | 23.1511 | 49.3633 | 28.0115 |
| 8 | i-C4 | 58.12 | 2.4550 | 2.1748 | 1.9502 | 3.4213 | 5.3502 | 3.7790 |
| 9 | n-C4 | 58.12 | 8.4310 | 8.3907 | 8.1113 | 8.5699 | 12.3442 | 9.2698 |
| 10 | i-C5 | 72.15 | 4.2500 | 4.9865 | 5.1760 | 1.7105 | 2.3072 | 1.8211 |
| 11 | n-C5 | 72.15 | 7.0010 | 8.4380 | 8.8383 | 2.0463 | 2.7750 | 2.1814 |
| 12 | C6 | 84.00 | 5.1240 | 6.4912 | 6.9091 | 0.4099 | 0.5790 | 0.4413 |
| 13 | Benzene | 78.11 | 0.0910 | 0.1157 | 0.1232 | 0.0060 | 0.0085 | 0.0064 |
| 14 | Toluene | 92.14 | 0.5350 | 0.6877 | 0.7355 | 0.0084 | 0.0126 | 0.0092 |
| 15 | E-Benzene | 106.17 | 0.4890 | 0.6302 | 0.6745 | 0.0022 | 0.0034 | 0.0024 |
| 16 | Xylenes | 106.17 | 1.3990 | 1.8033 | 1.9302 | 0.0050 | 0.0079 | 0.0055 |
| 17 | n-C6 | 86.18 | 5.9450 | 7.5378 | 8.0259 | 0.4529 | 0.6335 | 0.4864 |
| 18 | 224Trimethylp | 114.24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 19 | Pseudo Comp1 | 96.00 | 12.6630 | 16.2847 | 17.4167 | 0.1752 | 0.2701 | 0.1928 |
| 20 | Pseudo Comp2 | 107.00 | 12.5960 | 16.2302 | 17.3702 | 0.0653 | 0.1025 | 0.0722 |
| 21 | Pseudo Comp3 | 121.00 | 5.5050 | 7.0990 | 7.5998 | 0.0087 | 0.0141 | 0.0097 |
| 22 | Pseudo Comp4 | 138.83 | 6.1437 | 7.9248 | 8.4847 | 0.0024 | 0.0040 | 0.0027 |
| 23 | Pseudo Comp5 | 182.25 | 3.2993 | 4.2562 | 4.5570 | 0.0000 | 0.0001 | 0.0000 |

| | LP Oil | Flash Oil | Sales Oil | Flash Gas | W&S Gas | Total Emission |
|---|---|---|---|---|---|---|
| MW (lb/lbmol): | 80.86 | 94.22 | 97.73 | 34.78 | 44.66 | 36.61 |
| Stream Mole Ratio: | 1.0000 | 0.7752 | 0.7240 | 0.2248 | 0.0512 | 0.2760 |
| Stream Weight Ratio: | 80.86 | 73.04 | 70.76 | 7.82 | 2.29 | 10.10 |
| Total Emission (ton): | | | | 2.543 | 0.743 | 3.287 |
| Heating Value (BTU/scf): | | | | 2011.73 | 2542.74 | 2110.20 |
| Gas Gravity (Gas/Air): | | | | 1.20 | 1.54 | 1.26 |
| Bubble Pt. @100F (psia): | 290.50 | 32.81 | 12.68 | | | |
| RVP @100F (psia): | 93.75 | 22.27 | 11.64 | | | |
| Spec. Gravity @100F: | 0.66 | 0.69 | 0.69 | | | |

-- Emission Summary (December) ----------

| | Uncontrolled | Controlled |
|---|---|---|
| | ton | ton |
| Total HAPs | 0.0270 | 0.0005 |
| Total HC | 2.2730 | 0.0455 |
| VOCs, C2+ | 2.0270 | 0.0405 |
| VOCs, C3+ | 1.4870 | 0.0297 |
| CO2 | 0.0020 | |
| CH4 | 0.2460 | |

Uncontrolled Recovery Information:

| | |
|---|---|
| Vapor(SCF/day): | 1520.0000 |
| HC Vapor(mscfd): | 1.5200 |
| CO2(mscfd): | 0.0000 |
| CH4(mscfd): | 0.3800 |

GOR(SCF/STB): 23.3846

-- Emission Composition (December) ----------

| No | Component | Uncontrolled ton | Controlled ton |
|---|---|---|---|
| 1 | H2S | 0.0000 | 0.0000 |
| 2 | O2 | 0.0000 | 0.0000 |
| 3 | CO2 | 0.0020 | 0.0020 |
| 4 | N2 | 0.0010 | 0.0010 |
| 5 | C1 | 0.2460 | 0.0049 |
| 6 | C2 | 0.5410 | 0.0108 |
| 7 | C3 | 0.7680 | 0.0154 |
| 8 | i-C4 | 0.1370 | 0.0027 |
| 9 | n-C4 | 0.3350 | 0.0067 |
| 10 | i-C5 | 0.0820 | 0.0016 |
| 11 | n-C5 | 0.0980 | 0.0020 |
| 12 | C6 | 0.0230 | 0.0005 |
| 13 | Benzene | 0.0000 | 0.0000 |
| 14 | Toluene | 0.0010 | 0.0000 |
| 15 | E-Benzene | 0.0000 | 0.0000 |
| 16 | Xylenes | 0.0000 | 0.0000 |
| 17 | n-C6 | 0.0260 | 0.0005 |
| 18 | 224Trimethylp | 0.0000 | 0.0000 |
| 19 | Pseudo Comp1 | 0.0120 | 0.0002 |
| 20 | Pseudo Comp2 | 0.0050 | 0.0001 |
| 21 | Pseudo Comp3 | 0.0010 | 0.0000 |
| 22 | Pseudo Comp4 | 0.0000 | 0.0000 |
| 23 | Pseudo Comp5 | 0.0000 | 0.0000 |
| 24 | Total | 2.2780 | 0.0456 |

-- Stream Data (December) ----------

| No | Component | MW lb/lbmol | LP Oil mole % | Flash Oil mole % | Sales Oil mole % | Flash Gas mole % | W&S Gas mole % | Total Emission mole % |
|---|---|---|---|---|---|---|---|---|
| 1 | H2S | 34.80 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | O2 | 32.00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3 | CO2 | 44.01 | 0.0160 | 0.0012 | 0.0000 | 0.0669 | 0.0189 | 0.0580 |
| 4 | N2 | 28.01 | 0.0140 | 0.0001 | 0.0000 | 0.0620 | 0.0013 | 0.0507 |
| 5 | C1 | 16.04 | 6.8110 | 0.1905 | 0.0000 | 29.6385 | 2.8859 | 24.6779 |
| 6 | C2 | 30.07 | 7.9890 | 1.5481 | 0.0091 | 30.1976 | 23.3184 | 28.9220 |
| 7 | C3 | 44.10 | 9.2430 | 5.2094 | 2.0883 | 23.1511 | 49.3633 | 28.0115 |
| 8 | i-C4 | 58.12 | 2.4550 | 2.1748 | 1.9502 | 3.4213 | 5.3502 | 3.7790 |
| 9 | n-C4 | 58.12 | 8.4310 | 8.3907 | 8.1113 | 8.5699 | 12.3442 | 9.2698 |
| 10 | i-C5 | 72.15 | 4.2500 | 4.9865 | 5.1760 | 1.7105 | 2.3072 | 1.8211 |
| 11 | n-C5 | 72.15 | 7.0010 | 8.4380 | 8.8383 | 2.0463 | 2.7750 | 2.1814 |
| 12 | C6 | 84.00 | 5.1240 | 6.4912 | 6.9091 | 0.4099 | 0.5790 | 0.4413 |
| 13 | Benzene | 78.11 | 0.0910 | 0.1157 | 0.1232 | 0.0060 | 0.0085 | 0.0064 |
| 14 | Toluene | 92.14 | 0.5350 | 0.6877 | 0.7355 | 0.0084 | 0.0126 | 0.0092 |
| 15 | E-Benzene | 106.17 | 0.4890 | 0.6302 | 0.6745 | 0.0022 | 0.0034 | 0.0024 |
| 16 | Xylenes | 106.17 | 1.3990 | 1.8033 | 1.9302 | 0.0050 | 0.0079 | 0.0055 |
| 17 | n-C6 | 86.18 | 5.9450 | 7.5378 | 8.0259 | 0.4529 | 0.6335 | 0.4864 |
| 18 | 224Trimethylp | 114.24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 19 | Pseudo Comp1 | 96.00 | 12.6630 | 16.2847 | 17.4167 | 0.1752 | 0.2701 | 0.1928 |
| 20 | Pseudo Comp2 | 107.00 | 12.5960 | 16.2302 | 17.3702 | 0.0653 | 0.1025 | 0.0722 |
| 21 | Pseudo Comp3 | 121.00 | 5.5050 | 7.0990 | 7.5998 | 0.0087 | 0.0141 | 0.0097 |
| 22 | Pseudo Comp4 | 138.83 | 6.1437 | 7.9248 | 8.4847 | 0.0024 | 0.0040 | 0.0027 |
| 23 | Pseudo Comp5 | 182.25 | 3.2993 | 4.2562 | 4.5570 | 0.0000 | 0.0001 | 0.0000 |

| | LP Oil | Flash Oil | Sales Oil | Flash Gas | W&S Gas | Total Emission |
|---|---|---|---|---|---|---|
| MW (lb/lbmol): | 80.86 | 94.22 | 97.73 | 34.78 | 44.66 | 36.61 |
| Stream Mole Ratio: | 1.0000 | 0.7752 | 0.7240 | 0.2248 | 0.0512 | 0.2760 |
| Stream Weight Ratio: | 80.86 | 73.04 | 70.76 | 7.82 | 2.29 | 10.10 |
| Total Emission (ton): | | | | 1.761 | 0.515 | 2.276 |
| Heating Value (BTU/scf): | | | | 2011.73 | 2542.74 | 2110.20 |
| Gas Gravity (Gas/Air): | | | | 1.20 | 1.54 | 1.26 |
| Bubble Pt. @100F (psia): | 290.50 | 32.81 | 12.68 | | | |

| | | | |
|---|---|---|---|
| RVP @100F (psia): | 93.75 | 22.27 | 11.64 |
| Spec. Gravity @100F: | 0.66 | 0.69 | 0.69 |

-- Emission Summary (Total) ----------

| | Uncontrolled ton | Controlled ton |
|---|---|---|
| Total HAPs | 0.0790 | 0.0016 |
| Total HC | 6.5540 | 0.1311 |
| VOCs, C2+ | 5.8450 | 0.1169 |
| VOCs, C3+ | 4.2870 | 0.0857 |
| CO2 | 0.0050 | |
| CH4 | 0.7090 | |

-- Emission Composition (Total) ----------

| No | Component | Uncontrolled ton | Controlled ton |
|---|---|---|---|
| 1 | H2S | 0.0000 | 0.0000 |
| 2 | O2 | 0.0000 | 0.0000 |
| 3 | CO2 | 0.0050 | 0.0050 |
| 4 | N2 | 0.0020 | 0.0020 |
| 5 | C1 | 0.7090 | 0.0142 |
| 6 | C2 | 1.5590 | 0.0312 |
| 7 | C3 | 2.2140 | 0.0443 |
| 8 | i-C4 | 0.3940 | 0.0079 |
| 9 | n-C4 | 0.9660 | 0.0193 |
| 10 | i-C5 | 0.2360 | 0.0047 |
| 11 | n-C5 | 0.2820 | 0.0056 |
| 12 | C6 | 0.0660 | 0.0013 |
| 13 | Benzene | 0.0000 | 0.0000 |
| 14 | Toluene | 0.0020 | 0.0000 |
| 15 | E-Benzene | 0.0000 | 0.0000 |
| 16 | Xylenes | 0.0010 | 0.0000 |
| 17 | n-C6 | 0.0750 | 0.0015 |
| 18 | 224Trimethylp | 0.0000 | 0.0000 |
| 19 | Pseudo Comp1 | 0.0340 | 0.0007 |
| 20 | Pseudo Comp2 | 0.0140 | 0.0003 |
| 21 | Pseudo Comp3 | 0.0020 | 0.0000 |
| 22 | Pseudo Comp4 | 0.0000 | 0.0000 |
| 23 | Pseudo Comp5 | 0.0000 | 0.0000 |
| 24 | Total | 6.5610 | 0.1312 |

# Ursa Major Condensate Analysis

June 16, 2015

**FESCO, Ltd.**
**1100 FESCO Avenue - Alice, Texas 78332**

**For:** EdgeMarc Energy Holdings, LLC
1800 Main Street, Suite 220
Cannonsburg, Pennsylvania 15317

**Sample:** Ursa Major 9H
Separator Hydrocarbon Liquid
Sampled @ 262 psig & 82 °F

Date Sampled: 05/21/15 Job Number: 53014.002

**CHROMATOGRAPH EXTENDED ANALYSIS - GPA 2186-M**

| COMPONENT | MOL % | LIQ VOL % | WT % |
|---|---|---|---|
| Nitrogen | 0.014 | 0.004 | 0.005 |
| Carbon Dioxide | 0.016 | 0.007 | 0.009 |
| Methane | 6.811 | 2.917 | 1.331 |
| Ethane | 7.989 | 5.400 | 2.925 |
| Propane | 9.243 | 6.436 | 4.963 |
| Isobutane | 2.455 | 2.030 | 1.737 |
| n-Butane | 8.339 | 6.644 | 5.902 |
| 2,2 Dimethylpropane | 0.093 | 0.090 | 0.082 |
| Isopentane | 4.250 | 3.928 | 3.734 |
| n-Pentane | 7.001 | 6.414 | 6.151 |
| 2,2 Dimethylbutane | 0.197 | 0.208 | 0.206 |
| Cyclopentane | 0.000 | 0.000 | 0.000 |
| 2,3 Dimethylbutane | 0.376 | 0.389 | 0.394 |
| 2 Methylpentane | 2.708 | 2.841 | 2.842 |
| 3 Methylpentane | 1.843 | 1.902 | 1.934 |
| n-Hexane | 5.945 | 6.178 | 6.238 |
| Heptanes Plus | 42.720 | 54.611 | 61.546 |
| Totals: | 100.000 | 100.000 | 100.000 |

**Characteristics of Heptanes Plus:**

| | | |
|---|---|---|
| Specific Gravity | 0.7412 | (Water=1) |
| °API Gravity | 59.40 | @ 60°F |
| Molecular Weight | 118.3 | |
| Vapor Volume | 19.89 | CF/Gal |
| Weight | 6.18 | Lbs/Gal |

**Characteristics of Total Sample:**

| | | |
|---|---|---|
| Specific Gravity | 0.6577 | (Water=1) |
| °API Gravity | 83.65 | @ 60°F |
| Molecular Weight | 82.1 | |
| Vapor Volume | 25.42 | CF/Gal |
| Weight | 5.48 | Lbs/Gal |

Base Conditions: 14.650 PSI & 60 °F

Certified: FESCO, Ltd. - Alice, Texas

Analyst: XG
Processor: XGdjv
Cylinder ID: W-1586

David Dannhaus 361-661-7015

## TANKS DATA INPUT REPORT - GPA 2186-M

| COMPONENT | Mol % | LiqVol % | Wt % |
|---|---|---|---|
| Carbon Dioxide | 0.016 | 0.007 | 0.009 |
| Nitrogen | 0.014 | 0.004 | 0.005 |
| Methane | 6.811 | 2.917 | 1.331 |
| Ethane | 7.989 | 5.400 | 2.925 |
| Propane | 9.243 | 6.436 | 4.963 |
| Isobutane | 2.455 | 2.030 | 1.737 |
| n-Butane | 8.431 | 6.734 | 5.983 |
| Isopentane | 4.250 | 3.928 | 3.734 |
| n-Pentane | 7.001 | 6.414 | 6.151 |
| Other C-6's | 5.124 | 5.340 | 5.377 |
| Heptanes | 12.663 | 14.308 | 15.166 |
| Octanes | 12.596 | 15.435 | 17.049 |
| Nonanes | 5.505 | 7.547 | 8.510 |
| Decanes Plus | 9.443 | 14.971 | 17.694 |
| Benzene | 0.091 | 0.064 | 0.087 |
| Toluene | 0.535 | 0.453 | 0.600 |
| E-Benzene | 0.489 | 0.477 | 0.632 |
| Xylenes | 1.399 | 1.355 | 1.809 |
| n-Hexane | 5.945 | 6.178 | 6.238 |
| 2,2,4 Trimethylpentane | 0.000 | 0.000 | 0.000 |
| Totals: | 100.000 | 100.000 | 100.000 |

**Characteristics of Total Sample:**

| | | |
|---|---|---|
| Specific Gravity | 0.6577 | (Water=1) |
| °API Gravity | 83.65 | @ 60°F |
| Molecular Weight | 82.1 | |
| Vapor Volume | 25.42 | CF/Gal |
| Weight | 5.48 | Lbs/Gal |

**Characteristics of Decanes (C10) Plus:**

| | | |
|---|---|---|
| Specific Gravity | 0.7773 | (Water=1) |
| Molecular Weight | 153.9 | |

**Characteristics of Atmospheric Sample:**

| | | |
|---|---|---|
| °API Gravity | 67.85 | @ 60°F |
| Reid Vapor Pressure Equivalent (D-5191) | 11.68 | psi |

| QUALITY CONTROL CHECK | | | |
|---|---|---|---|
| | Sampling Conditions | Test Samples | |
| Cylinder Number | ------ | W-1568* | W-1238 |
| Pressure, PSIG | 262 | 251 | 251 |
| Temperature, °F | 82 | 69 | 69 |

* Sample used for analysis

FESCO, Ltd.

Job Number: 53014.002

**TOTAL EXTENDED REPORT - GPA 2186-M**

| COMPONENT | Mol % | LiqVol % | Wt % |
|---|---|---|---|
| Nitrogen | 0.014 | 0.004 | 0.005 |
| Carbon Dioxide | 0.016 | 0.007 | 0.009 |
| Methane | 6.811 | 2.917 | 1.331 |
| Ethane | 7.989 | 5.400 | 2.925 |
| Propane | 9.243 | 6.436 | 4.963 |
| Isobutane | 2.455 | 2.030 | 1.737 |
| n-Butane | 8.339 | 6.644 | 5.902 |
| 2,2 Dimethylpropane | 0.093 | 0.090 | 0.082 |
| Isopentane | 4.250 | 3.928 | 3.734 |
| n-Pentane | 7.001 | 6.414 | 6.151 |
| 2,2 Dimethylbutane | 0.197 | 0.208 | 0.206 |
| Cyclopentane | 0.000 | 0.000 | 0.000 |
| 2,3 Dimethylbutane | 0.376 | 0.389 | 0.394 |
| 2 Methylpentane | 2.708 | 2.841 | 2.842 |
| 3 Methylpentane | 1.843 | 1.902 | 1.934 |
| n-Hexane | 5.945 | 6.178 | 6.238 |
| Methylcyclopentane | 0.463 | 0.414 | 0.474 |
| Benzene | 0.091 | 0.064 | 0.087 |
| Cyclohexane | 0.920 | 0.792 | 0.943 |
| 2-Methylhexane | 2.622 | 3.081 | 3.200 |
| 3-Methylhexane | 2.296 | 2.664 | 2.801 |
| 2,2,4 Trimethylpentane | 0.000 | 0.000 | 0.000 |
| Other C-7's | 1.234 | 1.379 | 1.491 |
| n-Heptane | 5.127 | 5.979 | 6.256 |
| Methylcyclohexane | 0.148 | 0.150 | 0.177 |
| Toluene | 0.535 | 0.453 | 0.600 |
| Other C-8's | 9.071 | 10.912 | 12.175 |
| n-Octane | 3.377 | 4.373 | 4.697 |
| E-Benzene | 0.489 | 0.477 | 0.632 |
| M & P Xylenes | 0.538 | 0.528 | 0.696 |
| O-Xylene | 0.861 | 0.827 | 1.113 |
| Other C-9's | 3.579 | 4.809 | 5.503 |
| n-Nonane | 1.925 | 2.738 | 3.007 |
| Other C-10's | 3.088 | 4.559 | 5.312 |
| n-decane | 1.049 | 1.627 | 1.817 |
| Undecanes(11) | 2.446 | 3.706 | 4.379 |
| Dodecanes(12) | 1.292 | 2.115 | 2.534 |
| Tridecanes(13) | 0.716 | 1.257 | 1.526 |
| Tetradecanes(14) | 0.435 | 0.818 | 1.008 |
| Pentadecanes(15) | 0.211 | 0.425 | 0.530 |
| Hexadecanes(16) | 0.097 | 0.208 | 0.261 |
| Heptadecanes(17) | 0.054 | 0.123 | 0.156 |
| Octadecanes(18) | 0.032 | 0.076 | 0.096 |
| Nonadecanes(19) | 0.013 | 0.033 | 0.042 |
| Eicosanes(20) | 0.005 | 0.012 | 0.015 |
| Heneicosanes(21) | 0.002 | 0.007 | 0.009 |
| Docosanes(22) | 0.001 | 0.004 | 0.005 |
| Tricosanes(23) | 0.001 | 0.002 | 0.002 |
| Tetracosanes(24) | 0.000 | 0.001 | 0.001 |
| Pentacosanes(25) | 0.000 | 0.000 | 0.001 |
| Hexacosanes(26) | 0.000 | 0.000 | 0.000 |
| Heptacosanes(27) | 0.000 | 0.000 | 0.000 |
| Octacosanes(28) | 0.000 | 0.000 | 0.000 |
| Nonacosanes(29) | 0.000 | 0.000 | 0.000 |
| Triacontanes(30) | 0.000 | 0.000 | 0.000 |
| Hentriacontanes Plus(31+) | 0.000 | 0.000 | 0.000 |
| Total | 100.000 | 100.000 | 100.000 |

June 8, 2015

FESCO, Ltd.
1100 Fesco Avenue - Alice, Texas 78332

**For:** EdgeMarc Energy Holdings, LLC
1800 Main Street, Suite 220
Cannonsburg, Pennsylvania 15317

**Sample:** Ursa Major 9H

**Date Sampled:** 05/21/15

**Date Analyzed:** 06/03/15

**Job Number:** J53014

| FLASH LIBERATION OF HYDROCARBON LIQUID | | |
|---|---|---|
| | **Separator HC Liquid** | **Stock Tank** |
| Pressure, psig | 262 | 0 |
| Temperature, °F | 82 | 70 |
| Gas Oil Ratio (1) | ------ | 369.7 |
| Gas Specific Gravity (2) | ------ | 1.403 |
| Separator Volume Factor (3) | 1.2486 | 1.000 |

| STOCK TANK FLUID PROPERTIES | |
|---|---|
| Shrinkage Recovery Factor (4) | 0.8009 |
| Oil API Gravity at 60 °F | 67.85 |
| Reid Vapor Pressure Equivalent (D-5191), psi (5) | 11.68 |

| Quality Control Check | | | |
|---|---|---|---|
| | **Sampling Conditions** | **Test Samples** | |
| Cylinder No. | ------ | W-1568* | W-1238 |
| Pressure, psig | 262 | 251 | 251 |
| Temperature, °F | 82 | 69 | 69 |

(1) - Scf of flashed vapor per barrel of stock tank oil
(2) - Air = 1.000
(3) - Separator volume / Stock tank volume
(4) - Fraction of first stage separator liquid
(5) - Absolute pressure at 100 deg F

Analyst H.B.

* Sample used for flash study

**Base Conditions: 14.65 PSI & 60 °F**

Certified: FESCO, Ltd. - Alice, Texas

David Dannhaus 361-661-7015

June 4, 2015

**FESCO, Ltd.**
**1100 Fesco Ave. - Alice, Texas 78332**

**For:** EdgeMarc Energy Holdings, LLC
1800 Main Street, Suite 220
Cannonsburg, Pennsylvania 15317

**Sample:** Ursa Major 9H
Gas Evolved from Hydrocarbon Liquid Flashed
From 262 psig & 82 °F to 0 psig & 70 °F

Date Sampled: 05/21/15 Job Number: 53014.001

## CHROMATOGRAPH EXTENDED ANALYSIS - SUMMATION REPORT

| COMPONENT | MOL% | GPM |
|---|---|---|
| Hydrogen Sulfide* | < 0.001 | |
| Nitrogen | 0.036 | |
| Carbon Dioxide | 0.019 | |
| Methane | 23.942 | |
| Ethane | 25.902 | 6.888 |
| Propane | 23.256 | 6.371 |
| Isobutane | 4.208 | 1.369 |
| n-Butane | 11.375 | 3.566 |
| 2-2 Dimethylpropane | 0.097 | 0.037 |
| Isopentane | 2.845 | 1.035 |
| n-Pentane | 3.802 | 1.370 |
| Hexanes | 2.693 | 1.103 |
| Heptanes Plus | 1.825 | 0.804 |
| Totals | 100.000 | 22.542 |

**Computed Real Characteristics Of Heptanes Plus:**

| | | |
|---|---|---|
| Specific Gravity | 3.577 | (Air=1) |
| Molecular Weight | 102.03 | |
| Gross Heating Value | 5387 | BTU/CF |

**Computed Real Characteristics Of Total Sample:**

| | | |
|---|---|---|
| Specific Gravity | 1.403 | (Air=1) |
| Compressibility (Z) | 0.9848 | |
| Molecular Weight | 40.01 | |
| Gross Heating Value | | |
| Dry Basis | 2318 | BTU/CF |
| Saturated Basis | 2278 | BTU/CF |

*Hydrogen Sulfide tested in laboratory by: Stain Tube Method (GPA 2377)
Results: <0.013 Gr/100 CF, <0.2 PPMV or <0.001 Mol %

Base Conditions: 14.650 PSI & 60 Deg F

Certified: FESCO, Ltd. - Alice, Texas

Analyst: MR
Processor: HB
Cylinder ID: FL#15s

David Dannhaus 361-661-7015

# Attachment 3

## Control Device Purchase Order

HRP

# Attachment 4

## Enclosed Combustor Installation, Operation & Maintenance Manual

HRP

# Enclosed Combustors Installation, Operation & Maintenance Manual


Contact - 303-659-6801
www.leedfab.com

# WARNINGS

## WARNING

CAREFULLY READ AND FAMILIARIZE YOURSELF WITH THE CONTENT OF THIS MANUAL AND OTHER EQUIPMENT DOCUMENTATION BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE ANY EQUIPMENT

## CAUTION

INCORRECT INSTALLATION, OPERATION, ADJUSTMENT OR MAINTENANCE OF COMBUSTION EQUIPMENT CAN LEAD TO BODILY INJURY OR DEATH AND/OR SERIOUS DAMAGE TO PROPERTY. FOLLOW ALL SAFETY PRECAUTIONS AND MAINTENANCE RECOMMENDATIONS PRIOR TO, AND DURING USE OF ANY COMBUSTION EQUIPMENT


## CAUTION

PILOT IGNITION SYSTEM GENERATES 20KV - 40KV HIGH VOLTAGE OUTPUT WHICH CAN CAUSE BURNS OR CARDIAC ARREST. DO NOT TOUCH OR PLACE ANY OBJECT NEAR THE IGNITION COIL'S HIGH VOLTAGE TERMINAL OR CONNECTED IGNITION WIRE WHILE THE PRODUCT IS OPERATING. EVEN WITHOUT MAKING PHYSICAL CONTACT WITH THE TERMINAL, IT IS POSSIBLE TO DRAW A SPARK FROM SEVERAL INCHES AWAY


## CAUTION

FAILURE TO PROPERLY GROUND THE PILOT ASSEMBLY BACK TO IGNITOR GROUND SCREW MAY RESULT IN ACCIDENTAL ELECTROCUTION, PRODUCT DAMAGE, OR SIMPLY FAILURE TO IGNITE THE PILOT

# OVERVIEW

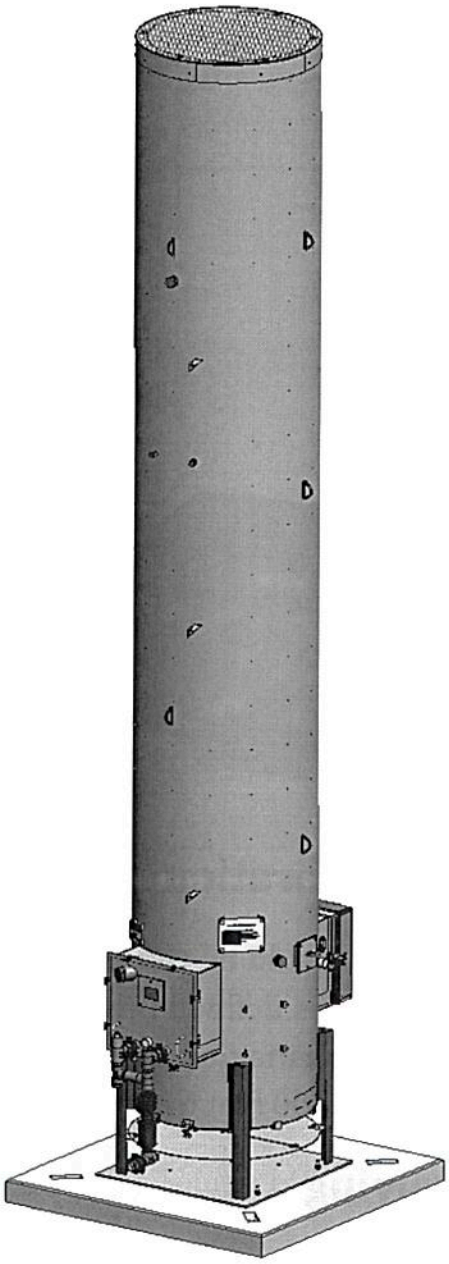
Combustion of natural gas, vapors and other residual gases at oil well facilities, gas and liquid loading facilities, tank farms and process plants is necessary to maintain environmental quality, safety and for regulatory compliance.

Leed combustion systems are designed to operate at high efficiencies (>99%). Typical operating pressures for combustors range from 0 to 16 oz. /in2 and can combust gas volumes to over 160 MSCFD. Enclosed Combustors are not designed to handle pressures exceeding 16 oz. /in2 and the main combustor gas should not be supplied from a higher pressure source such as a separator or wellhead.

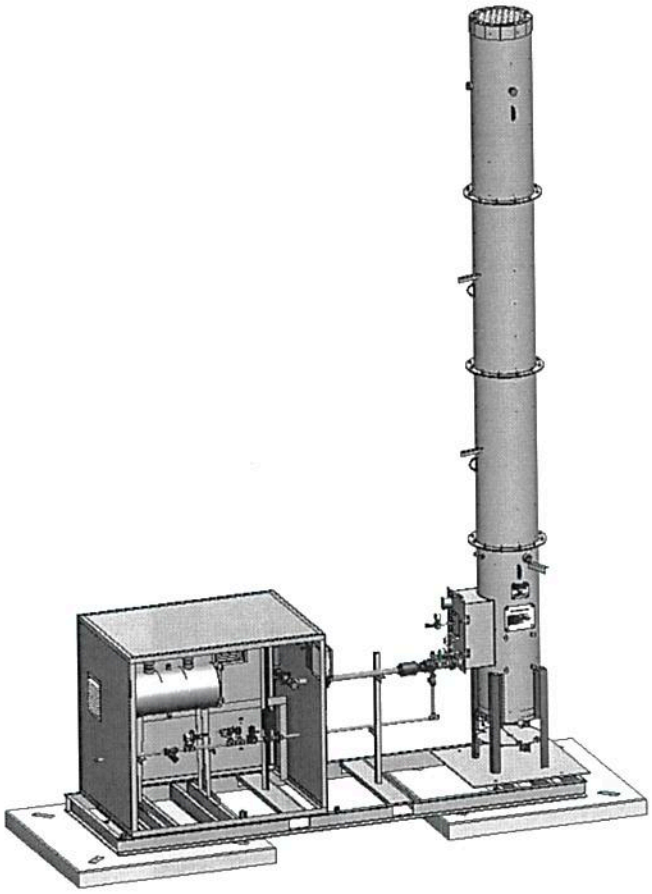
The Leed system is designed to be highly efficient and very simple to maintain. Only routine maintenance should be necessary to keep the combustor burning at peak performance.

# INSTALLATION

## Single Combustor Stack



## Skid Mounted Combustors



## Site Selection and Preparation

A location for the combustor should be chosen that is an appropriate distance from any gas emission source as defined in your company's design practices. In the absence of company specific design practices, it is recommended that the combustor location is 75 – 100 feet from any source of fugitive emissions.

## Shipping and Receiving

- Inspect all equipment upon receipt and notify Leed Fabrication, no later than 10 days after receipt, of any shipping damage.

- When loading and off-loading the combustor and other ancillary equipment, make sure proper equipment and personnel is employed and adequate support and surface protection is provided to avoid both structural and superficial damage on the supplied equipment. **Special attention is required with handling stacks to avoid damage to paint and wind diverters.**

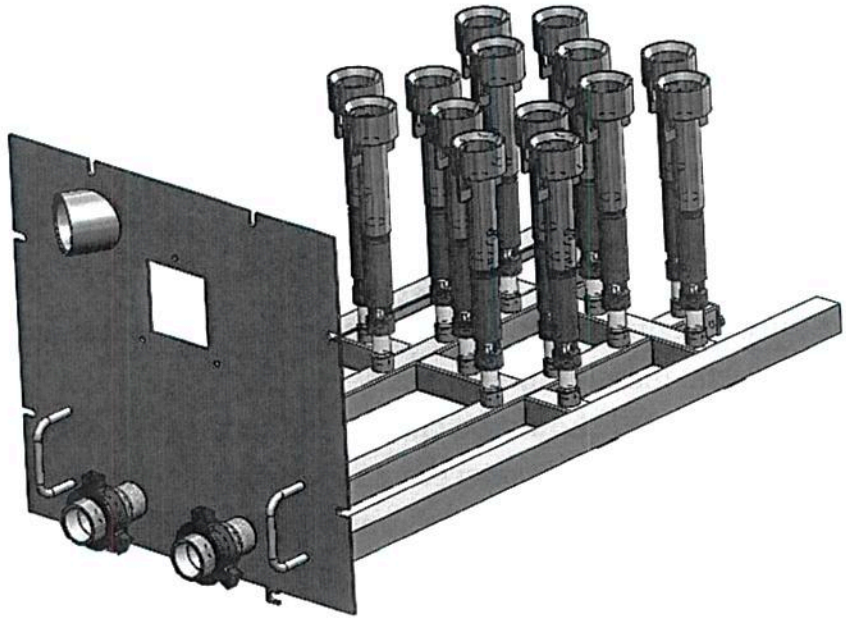
## Installation Process

- Make sure all equipment drawings supplied with unit are available prior to starting the installation process.
- Flat, stable ground should be chosen for setting the combustor. Concrete foundation or optional concrete pad provided with the combustor shall be used to make sure adequate support is available for the equipment.
- The combustor should be set with appropriate heavy lifting equipment and qualified personnel. The combustor base assembly is designed with lifting eyes located on the stack. Additional lifting lugs have been provided for off-loading and stabilization when setting the combustor.
- Before setting the stack, the insulation on the interior of the stack should be inspected. Remove any protective covering over the bird screen and air intake cells prior to setting the stack and thoroughly inspect the insulation. Any insulation damaged during transportation or storage shall be repaired or replaced.

**⚠ NOTE**

IT IS RECOMMENDED THAT THE BURNER BRACKET ASSEMBLY AND THE PILOT ASSEMBLY ARE REMOVED PRIOR TO SETTING THE COMBUSTOR STACK. THIS ENSURES THAT NO DAMAGE OCCURS TO THE BURNER HEADS OR PILOT

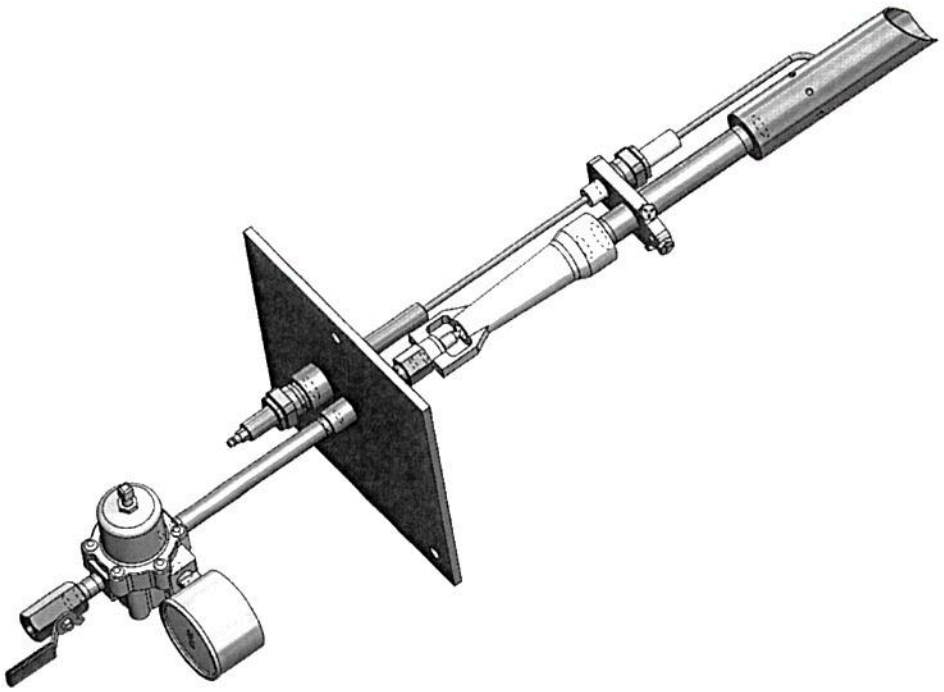
- If the Burner Bracket Assembly is not already in place, align the outside angles on the burner bracket with the angles located inside the burner box. Slide the assembly until it is self-supported.



- The burner heads are installed on the couplings located on the Burner Bracket Assembly. The lower nozzle should be adjusted to locate ¼" below the inlet of the Venturi Mixer. To get more premix air, the nozzle can be adjusted to NO MORE THAN 3/8" from the entrance of the Venturi Mixer.

> **⚠ NOTE**
>
> IF THE NOZZLE IS SET MORE THAN 3/8" FROM THE VENTURI ENTRANCE, THERE IS A POSSIBILITY THAT THE STACK AIR VELOCITY MAY DRAW THE GAS OUT OF THE VENTURI THROAT AND IGNITE. OUTSIDE OF THE BURNER HEAD

- Pilot Assembly is normally located on the side of the combustor stack. There is an alternate location for the pilot assembly on the front of the combustor stack. The assembly is easily accessible by sliding out the burner bracket or removing the plate in which the pilot assembly and igniter striker is mounted.



- Install ignition module and/or BMS system supplied with the unit. Please review attached manufacturer installation instructions before making any connections.
- If the inlet manifold is not already installed, proceed to install according to equipment drawings. Standard inlet manifold configuration shall include inline flame arrestor, block valve, gauges and other controls designed for the specific application.

## Interface Connections

- Make sure all equipment interface drawings are available prior to starting the installation process.

- All piping should be designed and installed in accordance with regulations, recognized piping standards and company safety standards.
- The inlet piping to the combustor should be designed and installed to avoid liquid collection points, minimize pressure drop and freezing issues in field piping leading to the combustor. Installation of a Liquid Knock Out tank is strongly recommended.

**⚠ NOTE**

CONTACT A LEED FABRICATION REPRESENTATIVE FOR LIQUID KNOCK OUT RECOMMENDATIONS IF THE COMBUSTOR IS INSTALLED FOR USE WITH POTENTIALLY WET FEED GAS. CALL 303-659-6801

- A block valve is located in front of the pilot regulator. Stainless steel tubing and fittings should be run from the pilot source gas to this valve. Care should be taken to avoid piping that may cause freezing or trip hazards.
- Install Electric supply to the ignition module and/or BMS system.
- Install ancillary controls such as remote start/ stop, ESD and thermocouples.
- Make sure conduit and wiring are properly routed and terminated to BMS box.
- Install any other instrumentation associated with the system. Refer to equipment drawings before making any connections.

# OPERATION

## Pre Start-up Activities

Inspect all components of the combustor according to the following guidelines:

- Inspect all piping and fittings. Care should always be taken to make sure that all piping connections are tight and no leaks exist in the system.
- Check to confirm that all burner heads are installed according to this manual.
- Make sure the sight glass and test port plugs are properly installed.
- Removable air intake cells should be inspected prior to start-up. Make sure there is no obstructions or access ways adjacent to air intake cells
- Make sure that the deflector plates are properly installed after inspection or cleaning.
- Make sure the ignition system is installed to manufacturer recommendations.
- Confirm pilot gas supply and power supply availability.
- Confirm that all areas surrounding the equipment ignition source are tested and free of flammable gases or vapors.

## Initial Settings

Make sure the following items are properly set before any testing or start-up activity is performed:

- Verify that block ball valve to the main gas supply is COMPLETELY CLOSED prior to starting the ignition sequence. If gas has leaked by the main supply ball valve, the operator must shut the valve and allow the combustor to vent for a minimum of 15 minutes prior to re-starting the ignition process.
- Check that pilot fuel gas is running to the combustor.
- Check that the pilot assembly is secured and the igniter is functioning properly.

- Open the block valve on the pilot assembly to flow gas through the pilot. Adjust the regulator to 6 – 8 psi. Close the ball valve to the pilot supply and allow the pilot gas to clear the stack for approximately 10 minutes.
- Use the ignition module and/or BMS system to ignite the pilot. If the pilot is not ignited after 10 seconds, shut the pilot gas and check the installation and function of the ignition system.
- Test Operation of automatic shut-off valve located on field piping leading to the combustor.
- Verify that any other operational safety shutdown systems, i.e. ESD, Thermocouples, PVRV, etc. are fully functional.
- System is now ready for initial operation

## Initial Operation

Once all initial setting and testing activities have been performed, combustor is ready for operation:

- Ignite Pilot using ignition module and/or BMS system to ignite the pilot. Confirm flame presence visually and also via annunciator (light) on ignition module and/or BMS system.
- To Ignite the Main Burner, slowly open the block valve to the main supply gas. The burner heads should ignite and the combustor will be running smoothly and quietly. If the heads do not light after 15 seconds, shut off the main supply line and allow the gas in the combustion stack to vent for a minimum of 15 minutes.
- For systems with automated shut-off valves, ignition would not occur until control system / BMS allows valve to open based on specific logic defined for the system.

# MAINTENANCE

## Preventive Maintenance

Weekly Inspection:

- Inspect all connections and make sure that they are tight and no leaks exist in the system.
- Inspect air intake cells. High pressure air might be used to clean up the air intake cells prior to starting the unit.
- Confirm proper operation of the ignition system / BMS.

Quarterly Inspection:

- Confirm that thermocouples and all basic instrumentation (gauges, sight glasses, transmitters/switches, etc.) are in correct working order. Replace faulty items as required.
- Inspect and clean detonation/flame arrestors as required.
- Confirm set points on pilot fuel gas system and adjust as required.
- Confirm proper operation of the ignition system / BMS.

**⚠ NOTE**

CONTACT A LEED FABRICATION REPRESENTATIVE FOR INFORMATION ABOUT OUR PREVENTIVE MAINTENANCE PROGRAMS. CALL 303-659-6801

## Troubleshooting

This section is designed to aid the operator to troubleshoot commons issues for other problems not included in this section please contact Leed Fabrication. The following is a list of issues with corresponding possible solutions:

## 1. Pilot does not ignite

a. Confirm power supply to ignition system / BMS. For systems with solar panels, confirm proper operation of the system, check battery and replace as required.
b. Confirm flow of fuel gas supply is available and all valves are correctly aligned.
c. If ignition system/BMS is energized (on), check internal fuse and replace as required.
d. Confirm pilot solenoid valves are energized during ignition sequence.
e. Confirm ignition system/BMS is properly programmed. See attached vendor documentation for additional detail
f. Check ignition wire is properly connected to ignition coils and to the ignition rod.
g. Check ignition rod gap inside pilot assembly. Gap should not be bigger than 1/2".
h. Check Pilot assembly is properly grounded.

## 2. Pilot has visible flame but cannot be detected

a. Adjust rod positioning and /or gas pilot gas pressure.
b. Check wiring inside ignition system / BMS.
c. Confirm grounding of pilot assembly.

## 3. Main Burner does not ignite

a. Confirm flow on gas/vapor line and that all valves are open and correctly aligned.
b. See item 5 for additional troubleshooting information.

## 4. Stack High Temperature

a. Verify flow rate and any possible process upset upstream of the combustor. Combustor might be operating outside design range (over fired).
b. Check stack and line thermocouples for thermocouple failure.

c. Confirm proper wiring termination of thermocouples inside ignition system / BMS

## 5. High Pressure on inlet line / Decreased capacity

a. Check for Process Line blockage. Verify that there are not liquid slugs or liquid carryover from process upsets.
b. Check that all block valves are operating correctly. Replace as required.
c. Check for inline flame/detonation arrestor blockage. Clean and/or replace as required.
d. Check for burner blockage. Look inside the stack through sight port and visually confirm that there are not solid objects or liquids on top of the burner. Pull out burner rack and clean and or replace burner heads as required.

## 6. Smoking

a. Check for Process Line blockage. Verify that there are not liquid slugs or liquid carryover from process upsets. See item 5 for additional troubleshooting information.
b. Confirm and air intake are clean and there is no inside or outside blockage. Blow out with pressure air as required.
e. Heavy hydrocarbons or water in the gas/vapor stream dropping out of vapor phase. Troubleshoot process upstream of the combustor to avoid liquid carryovers. Pull out burner rack and clean and or replace burner heads as required.
f. Check for burner blockage. Look inside the stack through sight port and visually confirm that there are not solid objects or liquids on top of the burner. Pull out burner rack and clean and or replace burner heads as required.

# SPARE PARTS LIST

The following spare parts list is the minimum recommendation for the commissioning and operation of this type of unit. Customer specific details such as brand names, model numbers and quantities may apply. Additional spare parts requirements such as 2 year operation are not covered in this list:

1. Pilot Pressure Gauge
2. Main Line Pressure Gauge
3. Stack Thermocouple
4. Pilot Thermocouple or other applicable flame detection device
5. Spare Ignition Rod
6. Solenoid Valves Pilot
7. Shut-off Valve Assembly or Shut-off valve actuator

# REFERENCE DRAWINGS

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# VENDOR LITERATURE

## Ignition System / BMS